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White Potato Storages for New Jersey, Long Island, and Southeastern Pennsylvania

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SUMMARY

Storage of white potatoes produced in the New Jersey, Long Island, and the southeastern Pennsylvania area is a practical method of minimizing price fluctuations in local markets. In this area potatoes can be stored for 8 months after harvest if recommended storage conditions are observed.

Either refrigerated or common storage structures are suitable for the area, but higher initial and operating costs tend to make refrigerated storages economically impractical for potatoes.

High ground temperatures during the fall months retard cooling in storages below the ground. For this reason insulated structures above the ground are considered most desirable for potato storage.

Weather during the storage season makes forced ventilation desirable in all storages. Forced ventilation systems should provide for circulation of outside air or recirculation of storage air through the stored potatoes. Automatic control of such ventilation systems is essential.

Structures intended for bulk storage of white potatoes must be capable of supporting the load imposed by the piled potatoes in addition to other loads, such as wind, and snow, that are encountered in storage structures. The storages should incorporate features of design that facilitate handling, grading, and shipping. Concrete floors having integrally poured, combination ventilating and unloading ducts are a desirable feature in bulk storages.

Palletized handling is adaptable to either bulk or bag storage of white potatoes. Pallets used for storage and handling may also serve as ventilating ducts when properly placed. Palletized 1-ton boxes constitute an efficient method of bulk handling of potatoes, but the cost of pallets and fork-lift trucks restricts this method to large storages.

WHITE POTATO STORAGES FOR NEW JERSEY, LONG ISLAND, AND SOUTHEASTERN PENNSYLVANIA

By Benjamin C. Haynes, Jr., agricultural engineer 1/

Potatoes have been stored in the New Jersey, Long Island, and southeastern Pennsylvania area, with varying degrees of success, for a number of years. The purpose of this publication is to present information concerning construction, air circulation, and ventilation of storage houses, which if properly applied, will provide satisfactory conditions. This information applies both to the construction of new storage facilities and to the modification of existing structures.

RECOMMENDED STORAGE CONDITIONS

Potatoes will have best texture, color, and flavor when cooked or made into chips if stored at 50° to 60° F., but can be stored at these temperatures for only 2 to 4 months after digging. Common varieties of potatoes can be kept sprout-free at 50° F. for 3 to 4 months following maturity, whether matured in field or storage. At this temperature cooking quality will remain good. At 40° F. white potatoes will remain dormant for 6 to 9 months, depending upon the variety. At temperatures of 40° F. and below, potatoes tend to become undesirably sweet, a condition partly overcome by exposure to temperatures in the range of 70° to 80° F. for about 2 weeks at the end of storage. In order to store potatoes successfully for 5 to 9 months, it is necessary to meet certain recommended storage conditions.

A relative humidity of 85 to 90 percent is necessary to minimize shrinkage. Higher relative humidities often are undesirable, as they frequently result in moisture condensation. Condensation, particularly on storage ceilings, should be avoided, both to preserve the storage structure and to prevent water dripping on stored potatoes.

Seed stock that is to be held 6 to 9 months will store satisfactorily under the same storage conditions recommended for table stock. If table or seed potatoes are to be held longer, storage temperature should be reduced to 36° to 38° F. "At the reduced storage temperature, stock should remain dormant indefinitely." 2/

1/ The author is a member of the Agricultural Engineering Research Branch of the Agricultural Research Service.

2/ The Commercial Storage of Fruits, Vegetables, and Florist's Stock. U. S. Dept. Agr. Cir. 278, p. 37. Dec. 1942.

In average weather in the New Jersey, Long Island, and southeastern Pennsylvania area, it is possible to maintain the following temperatures in a well-constructed, properly ventilated, unrefrigerated storage: Early October to early November, 50° to 60° F.; early November to mid-November, 40° to 50° F.; mid-November to mid-March, 40° F.

It is not uncommon for storage temperatures to rise 10° F. during a week of unseasonably warm weather in the middle of the storage season. If outside temperatures average 55° F., and make ventilation undesirable for a total of 4 days, storage temperature probably will rise from an average of 40° F. to an average of 50° F. Short periods of warm weather that raise temperatures above the desired storage temperature have little effect on long-term storage. Relative humidity of the storage air in a good structure will average 90 percent throughout the storage season.

TYPES OF STORAGE STRUCTURES

Suitable storage structures for this area are of two types: (1) Refrigerated, and (2) common.

Because of the higher initial and operating costs, it is doubtful whether refrigerated storages are economically practical in the area.

Common storages may be further described as aboveground, banked, or below-ground. They may be ventilated by gravity or forced air and may use shell or through-air circulation.

In this area, during the fall months aboveground storages probably will cool somewhat faster than below-ground storages because fairly high ground temperatures retard cooling below-ground storages. Sometimes soil conditions make costs excessive for basement walls. Aboveground storages are most easily adapted to present methods of loading and unloading trucks and to methods of handling, grading, and shipping potatoes. Aboveground storage is also suitable for a number of other agricultural and commercial uses.

Storages depending upon gravity ventilation and circulation are slow to cool during the fall months, and are subject to wide temperature ranges that often cause sprouting in one place and freezing in another. Storages designed for forced-air ventilation and circulation will cool rapidly, and recirculation will maintain a narrow temperature range.

Shell-cooled potato storages depend on gravity-induced convection currents within the bin and on radiation and heat conduction from the potato pile to the bin walls. The heat is carried off by cool air passing through ducts enclosed in the bin walls. The ventilating air does not come in contact with the potatoes until it is tempered by going under the floor and up the outer wall. The rate of cooling with this type of

ventilation and circulation depends to a large extent upon the distance from the bin wall and top to the center of the potato pile, and the ratio of the bin wall surface area to the total cubic content of the bin. Deposits of trash and dirt also delay the rate of cooling. Shell-cooling is slower than through-cooling, assuming equal air flow and similar temperatures.

Through-cooling is attained by passing air directly through, and in contact with, the potato pile. Through-cooling is recommended for this area because it results in quicker cooling for this climate. Through-cooling also maintains a narrower temperature range than shell-cooling.

Aside from financial considerations, three major factors influence the design of a potato storage. First, a storage should be designed for adequate capacity and separation of potato lots. Second, the storage must be designed to maintain the potatoes in a good state of preservation. Third, provisions for handling the potatoes in and out of storage (including any special handling, grading, and processing) should be incorporated in the design.

The problem of holding white potatoes within the storage structure should be considered from two standpoints. First, the structure must be designed to withstand external forces of wind and snow and the pressure of potatoes from the inside. Second, provision of bins to separate lots and varieties may be desirable.

In common storages, forced-air ventilation, circulation, and recirculation aid in maintaining potatoes in good physical condition. Ventilation equipment and ducts should not interfere with storage space and handling operations. In many cases, underfloor ducts can be used for the dual purpose of unloading potatoes and ventilating.

One good method of handling potatoes into bulk storage is by use of a bin loader. Bin loaders are equipped with elevating conveyors that can be raised or lowered, and the entire mechanism is wheel-mounted for portability. These machines are easily maneuverable, but it is advantageous to have the storage area as free of obstruction as possible. If underfloor ducts are intended for conveying from bins, they must be designed to allow room for insertion of conveyors, and the duct tops should be removable.

TYPES OF VENTILATING SYSTEMS

Common storages have been used in a large part of the United States for a number of years. These have varied from the old-time root cellar to modern, aboveground, insulated storages.

As the size of the storages has increased, and mechanical handling of crops has progressed, it has been found necessary to improve storage

ventilation and circulation in order to remove the heat of respiration produced by the crop stored. Ventilation may be accomplished by gravity or forced circulation and regulated manually or by thermostatically-controlled dampers.

Although good storage conditions can be secured in small storages with gravity ventilation, these conditions are seldom obtained because they require close attention by management. For larger storages forced-air ventilation with automatic regulation is so much better that the discussion in this report will be confined to forced ventilation circulation and recirculation systems. The systems described are planned to provide 1 cubic foot of air per minute for each 150 pounds of potatoes.

Two-Position Controlled Ventilation

Two-position damper-controlled ventilation has been successfully used in the colder Northern States for a number of years. In such a system, the fan, together with a housing and damper, is arranged to (a) introduce and circulate cooler outside air in a storage, and exhaust warmer inside air, or (b) recirculate the air within a storage.

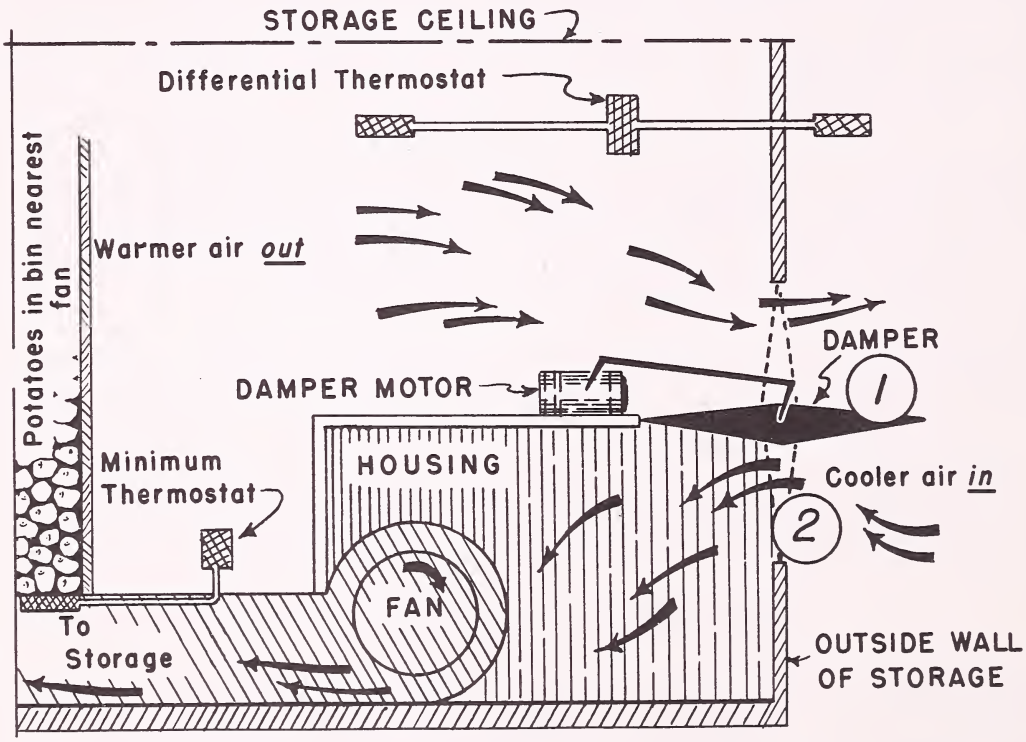

Figure 1.- Diagram of locations of fan housing, thermostats, air duct, and two-position damper: (1) Shows damper in ventilating position; and (2) shows damper in position for recirculation.

The damper is moved to one of two positions, as shown in figure 1, by a two-position damper motor. The positioning of the damper is controlled by a differential thermostat and a minimum thermostat wired in series with the damper motor. The differential thermostat allows ventilation only when outside air is cooler than the potatoes. The minimum thermostat causes the damper to move to a position that will stop ventilation and allow recirculation of storage air whenever the ventilating air first touching the potatoes has reached a set minimum temperature. The minimum thermostat may be set at 60° F. for initial 10 days of storage for wound healing, 40° F. for long-period storage, or other temperatures to meet market needs.

Proportioning Ventilation Control

In the New Jersey, Long Island, and southeastern Pennsylvania area, proportioning ventilation control is giving good results in average weather.

Proportioning control involves the use of a multi-position damper, rather than a two-position damper. The controls required for this type of installation consist of a differential thermostat, a proportioning thermostat, a proportioning damper motor, and a cycle repeater (time switch).

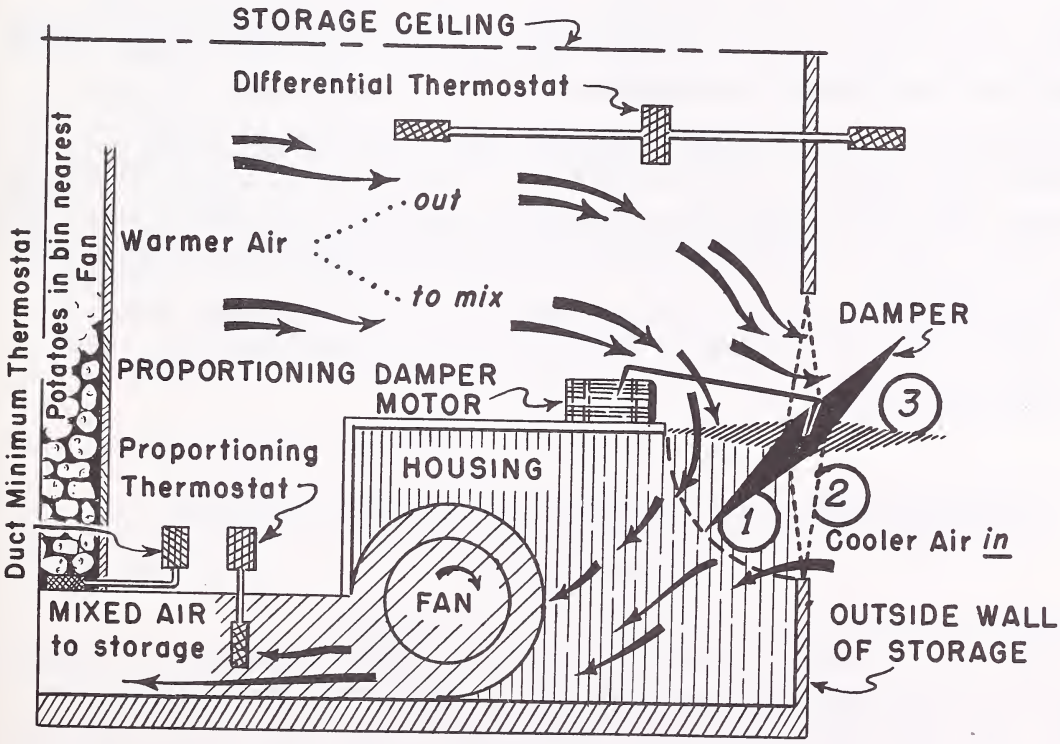

Figure 2.--Diagram of locations of fan housing, thermostats, air duct, and proportioning damper: (1) Shows damper in partly closed position for ventilation with a mixture of outdoor and recirculated air, (2) in position for recirculation, and (3) in full-open position for ventilation.

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As shown in figure 2, when the outside air is warmer than the maximum temperature of the stored potatoes, the circuit completed through the differential thermostat causes the proportioning damper motor to move the damper to the full closed position at (2). Under these conditions, storage air is recirculated.

When the outside air temperature falls below the maximum potato temperature, the differential thermostat completes the circuit through the proportioning thermostat to the proportioning damper motor. As long as the temperature of the outside air remains above the temperature setting of the proportioning thermostat, the proportioning damper motor will hold the damper in the full open position at (3). Under this condition, outside air is used to ventilate and cool the storage.

As the temperature of the outside air falls, the proportioning thermostat causes the proportioning damper motor to turn the damper to a partially closed position at (1). This means that some air in the storage is being returned to the fan housing to mix with outside cold air before the outside air is admitted to the storage space. The proportioning thermostat will continually adjust the damper to a position that will maintain the temperature of the mixed air at the setting of the proportioning thermostat.

When the storage temperature reaches the setting of the proportioning thermostat, this thermostat will move the damper to the full closed position and thus provide the recirculation of the storage air.

The blower may be allowed to operate continuously, but it is recommended that operation of the blower be restricted to about 10 minutes out of each hour during periods of recirculation when the damper is closed. In this area, intermittent operation during recirculation may reduce power costs by 30 percent. Intermittent fan operation, during recirculation, may be accomplished by the use of a limit switch on the damper motor or damper, which controls the blower motor through a cycle repeater. The blower must be allowed to operate continuously whenever the damper is open or partially open.

SUGGESTED DESIGN AND CONSTRUCTION OF NEW STORAGE HOUSES

Storage Capacity

Storage capacity can be computed by the formula:
L x W x H ÷ 1.43 = bushels capacity, when L, W, and H represent, in feet, respectively, the length and width of the storage, and the depth of the potatoes. In this area, the depth to which potatoes may be piled should not exceed 16 feet when forced-air circulation is used, or 6 feet when only gravity ventilation and circulation are provided. The above figures are based on a standard 60-pound bushel and potatoes weighing 42 pounds

per cubic foot. The capacity thus determined will vary slightly from actual capacity because of size variations of the potatoes. Allowance should be made for space needed for alleys and work areas.

Wall Construction

The walls of a below-ground or a banked storage must be designed to resist the full lateral pressure of the surrounding earth when the storage is empty. This lateral pressure will vary with the type of soil in which the storage is constructed. Local builders usually can advise on safe construction of cellar walls.

Danger of caving-in of walls can be reduced by first backfilling the original earth level. When this fill has settled, usually not until after a heavy rain, the banking can be finished. Care must be taken that no pressure is applied on the wall by the equipment used in backfilling.

In addition to designing aboveground storage walls to accept the lateral pressure of the potato pile, consideration must be given to the proper ties and sway braces to prevent wracking of the structure by wind when empty, or when loaded unequally.

The primary factors determining stud size are the depth of the potato pile 3/ and the length of the studs.

Example: Assuming a maximum roof span of 50 feet (no roof support by partitions), roof slope of 6/12, and total roof load (live and dead) of 25 pounds per square foot, the following information will hold true:

1. 2- by 8-inch studs, 14 feet long and spaced 16 inches on center, will support potatoes piled to a depth of 11 feet.

2. 2- by 6-inch studs, 12 feet long and spaced 16 inches on center, will support potatoes piled to a depth of 8 feet.

3. 2- by 6-inch studs, 10 feet long and spaced 16 inches on center, will support potatoes piled to a depth of 9 feet.

With good grade sound lumber, the stud sizes indicated above should be satisfactory for a building up to 50 feet wide with trussed roof and no interior posts.

3/ Lateral potato pressures increase from about 35 pounds per square foot at 4-foot depth to 60 pounds per square foot at 8-foot depth and 100 pounds per square foot at 16-foot depth.

Exterior and Interior Wall Sheathing

Partitions and interior wall surfaces may be satisfactorily sheathed with 1-inch boards or 26-gage galvanized steel with $2\frac{1}{2}$-inch corrugations (fig. 3).

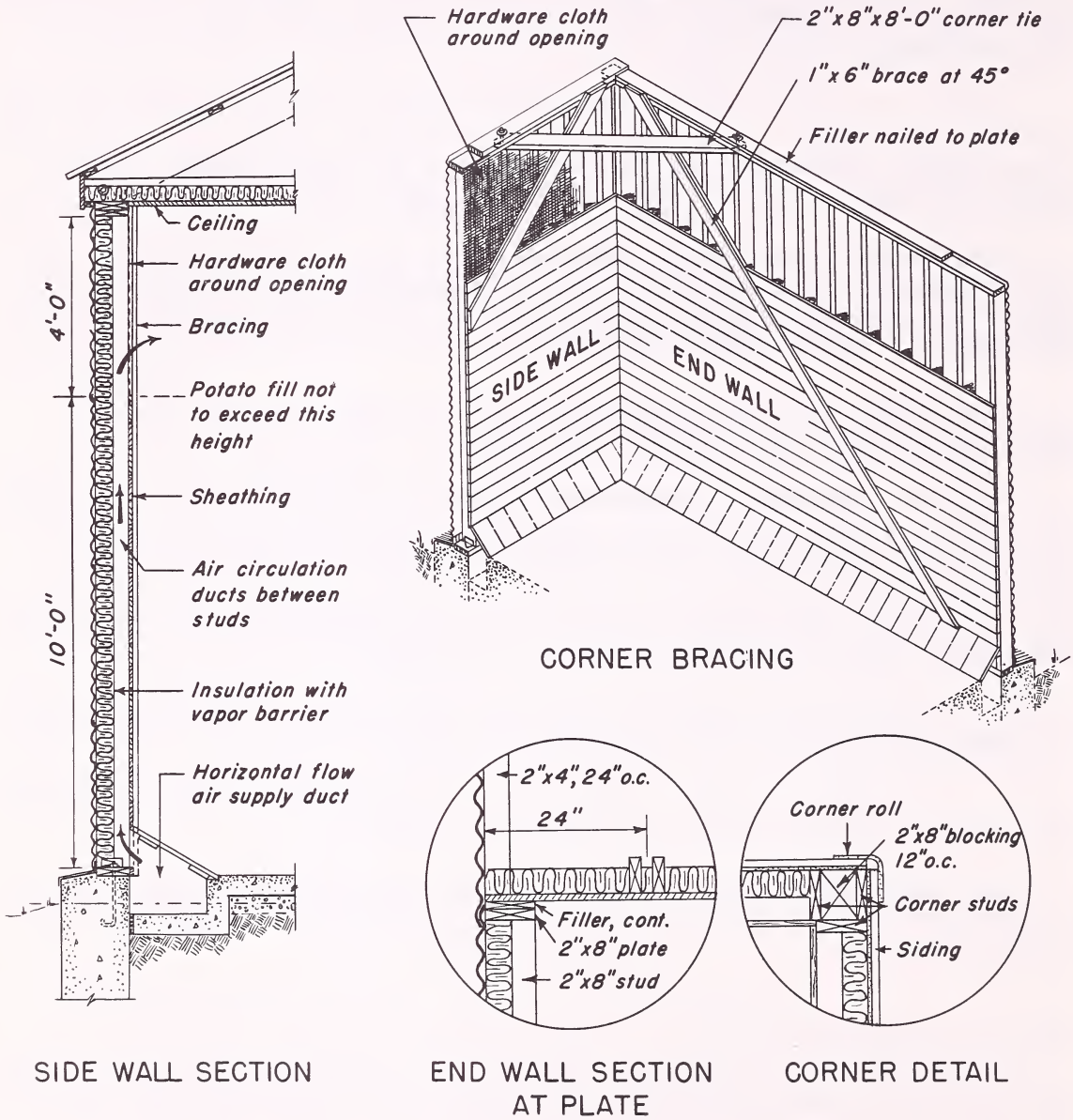

Figure 3.--Wall and ceiling construction details for a typical aboveground potato storage for Long Island, New Jersey, and southeastern Pennsylvania.

Exterior wall surfaces of an aboveground storage structure may be sheathed with any conventional material such as wood, galvanized steel, aluminum, or cement asbestos. A light-colored surface is preferred as it reflects heat from the sun better than dark surfaces.

Roof Design

A number of types of roof trusses permit unsupported roof spans up to 50 feet. Wood-trussed rafters can be prefabricated on the ground and raised to position with a farm tractor or block and tackle.

Trussed rafters are adaptable to a variety of roof spans ranging up to 50 feet. 4/ Diagonal 1- by 6-inch bracing should be applied to the underside of rafters from eaves to ridge at each end of building to act as wind-bracing for the roof. The top of ceiling joists should be similarly braced with 1- by 6-inch boards applied horizontally and extended at a 45° angle from each corner of the building to the opposite side wall plate. If the length of the building is more than twice its width, there should be a cross partition near the center to stiffen the building against wind pressure. The partition should be braced with diagonal braces and anchored to the foundation the same as the exterior walls.

Overhead attic space formed by trussed rafter construction may be used to house ventilating equipment and also for lightweight storage. Special metal connectors are used to fasten the end of the trussed rafters to the wall plate.

The side walls tied by trussed rafters are adequate to withstand the lateral pressure exerted by the potatoes. The end walls need to be tied similarly. A solid ceiling nailed to the end wall plates will serve as a tie if the end joints of the ceiling boards are staggered and well-nailed to the underside of ceiling joists.

Insulation Requirements

Insulation is necessary to prevent freezing of potatoes during cold weather, to reduce overheating during warm weather, and to reduce moisture condensation on interior surfaces, particularly the ceiling.

As condensation may occur any place within an insulated wall, it is desirable that a moisture barrier be placed on the storage side of the insulation. Fifty-five-pound smooth-surfaced composition roofing, shiny-surfaced asphalt-saturated paper, or metal foil is satisfactory.

4/ Plans for roof trusses for potato storage houses may be obtained from agricultural engineers of the State Extension Services.

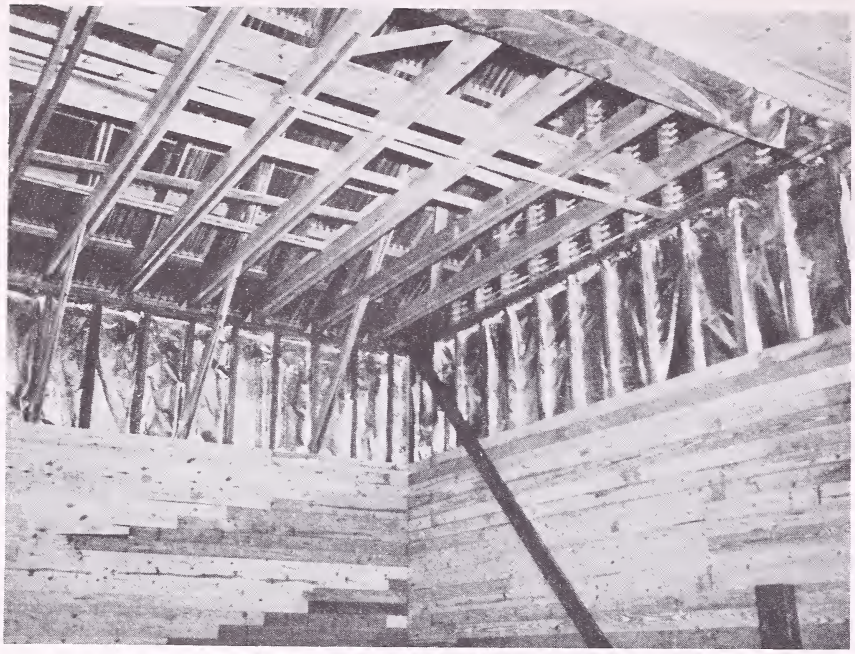

Figure 4.--Vapor barrier of metal foil in wall of potato storage. The insulation is outside of the barrier. Note air circulation spaces between vapor barrier and wood sheathing on inner face of wall.

A vapor barrier of metal foil is shown in figure 4. This barrier prevents the movement of moisture from the storage into the insulation, which would otherwise become wet and lose insulating value.

For the Long Island, New Jersey, and southeastern Pennsylvania area it is recommended that at least the equivalent of 3 inches of mineral wool or fiber glass insulation be installed between studs in all walls. Generally more insulation is needed in ceilings than in walls. If aluminum or other reflective roofing is used, and the area between roof and ceiling is well-ventilated, 4 inches of insulation should be considered a minimum for ceiling insulation.

Floor Design

Wherever possible, floors should be of poured concrete construction, and reinforced to withstand temperature changes.

Although some warehousemen think an earth floor is desirable for maintaining higher humidities within a storage, present general belief is that the small gain does not balance the disadvantages because earth makes a poor work floor.

Handling equipment is operated with maximum efficiency on concrete floors. In addition, concrete ventilating and unloading ducts may be poured integrally with the floor (fig. 5).

Concrete floors should be poured on a gravel fill on well-tamped earth. An expansion joint should be provided at the junctions of the floor and walls. In wet locations drain tile should be laid around the foundation of a below-ground storage and connected to a suitable outlet, or a sump pump should be provided to drain water from the lowest part of the floor duct system.

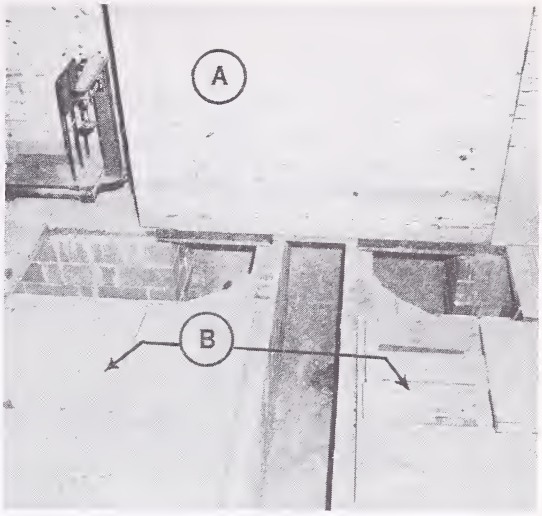

Figure 5.--Air ducts in concrete floor. Note fan and damper housing A and plank covers for ducts B.

Floor Ventilating and Unloading Ducts

Ventilating ducts may be designed with two thoughts in mind. First, the ducts should be proportioned to assure uniform air delivery throughout the storage area. Second, the ducts should be large enough for insertion and operation of an unloading conveyor. A conveyor with a 16-inch wide belt is most practical. This requires 20-inch wide ducts, as shown in this report.

The depth of the delivery duct must be varied to permit uniform distribution of air throughout the entire length. The proper depth may be obtained by sloping or stepping the bottom of the duct (fig. 6). The far end (E) of each delivery duct must be made deeper than necessary for uniform air flow in order to accommodate the unloading conveyor. It is recommended that ventilating ducts be at least 14 inches deep in order to provide space for the conveyor. Sectionalized, false, wooden bottoms or removable damper boards may be inserted to correct the air flow characteristics. These false bottoms or dampers are removed from the duct before the unloader is inserted.

A number of factors must be considered in designing the duct system. The following information is presented to simplify the design procedure:

1. The first step is to lay out, on the floor plan for the storage, a delivery and distribution duct system to provide adequate distribution of air and space for handling potatoes. Several possible sketches are shown in figure 7. Figure 7A, C, and F would be most suited to a large storage, as none of the long duct sections carries a large volume of air.

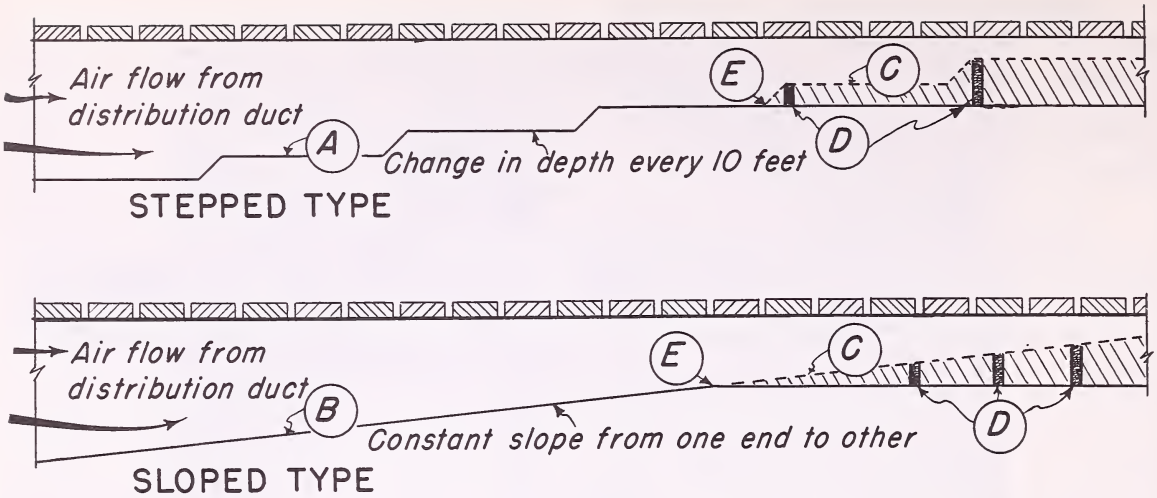

Figure 6.--Longitudinal section of ducts in floor, showing methods of adjusting air flow by A, stepping bottom depth; B, sloping bottom; C, removable false bottom; D, removable board dampers; and E, end section of depth to accommodate conveyor.

2. Assume that the storage is 32 by 60 feet. The floor plan decided upon is similar to figure 7A. A 20-inch-wide duct will be used. The duct layout plan for this example is indicated in figure 8.

From table 1 it is apparent that a duct 60 feet long and 20 inches wide must have a depth of 18 inches. Section F of the duct layout shown should have a depth of 18 inches. Referring again to table 1, opposite lengths of 50 feet, 40 feet, and so on, sections E, D, C, B, and A should have depths of 16 inches, 14 inches, 12 inches, 10 inches, and 8 inches, respectively.

3. As sections G, H, and I of the duct layout are tight-covered ducts, section G will be carrying the same quantity of air as Section F. Hence, section G should be the same size as section F (20 inches wide and 18 inches deep).

4. Section H must carry sufficient air for two 60-foot ducts. Referring again to the chart of duct sizing, under the second column (for two attached ducts), it is seen that the proper sizing for section H is 20 inches wide and 29 inches deep.

5. Section I must carry sufficient air for four 60-foot ducts.

In order that duct covers will not be unsupported over a span greater than 24 inches, it will be necessary to separate duct section I into two ducts. Each of these two ducts should have the same dimensions as section H (20 inches wide and 29 inches deep).

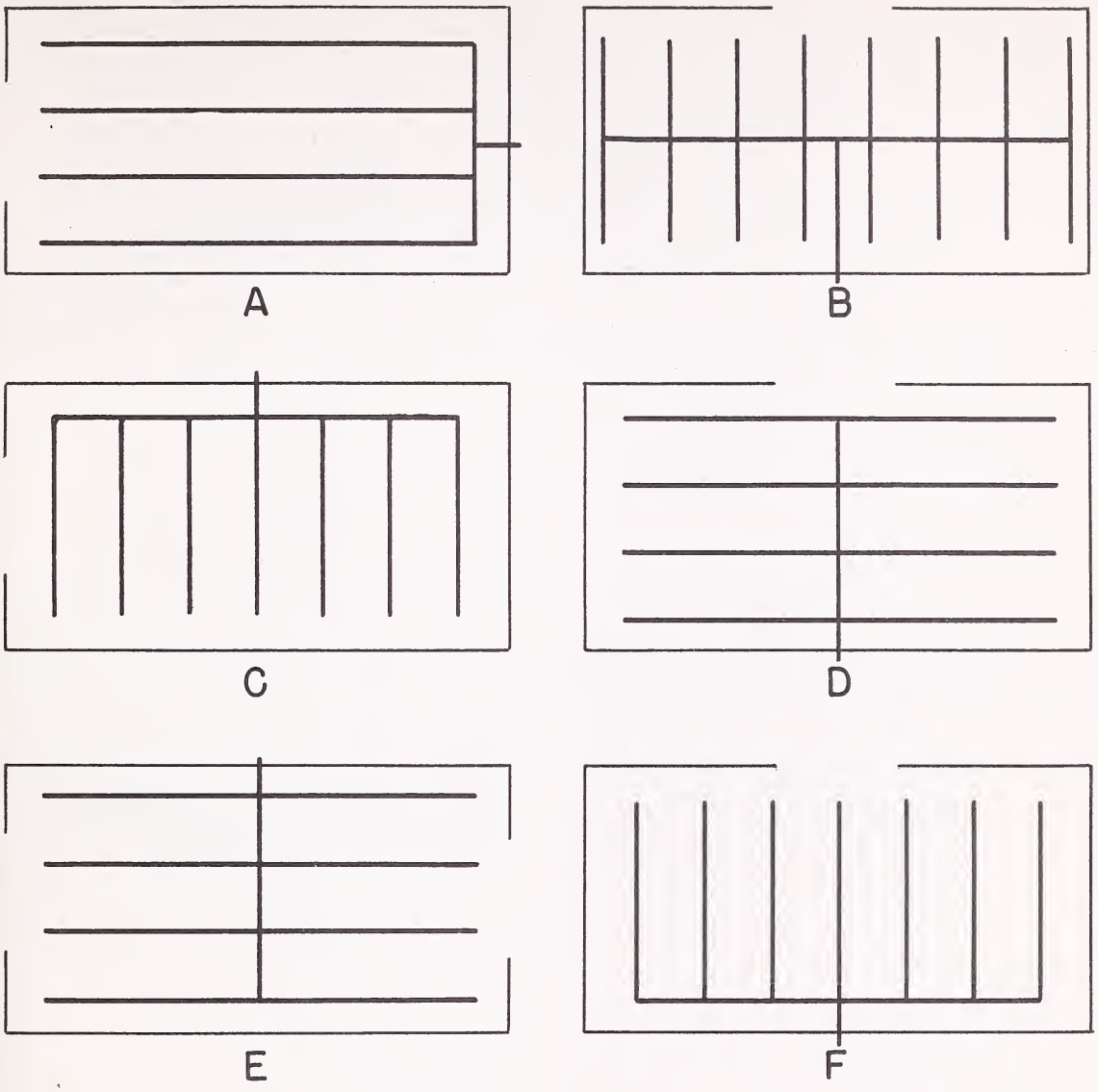

Figure 7.--Patterns for layout of air ducts for potato storage.

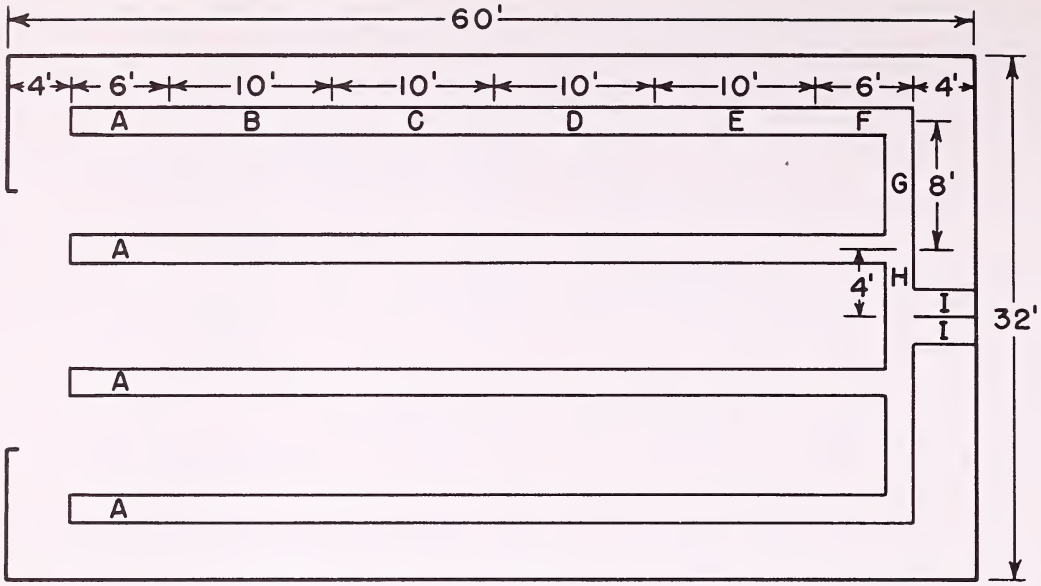

Figure 8.--Duct layout for 60- by 32-foot potato storage.

The total volume of air delivery required for the storage may be computed from the following tabulation:

Depth of potato storage pile	Quantity of air required per 10 feet of length of delivery duct spaced 8 feet on center
Feet	Cubic feet per minute
6	135
8	180
10	225
12	270

If the plan is to pile potatoes to a depth of 8 feet in the 32- by 60-foot storage previously mentioned, the total quantity of air required is: Four delivery ducts x 60 feet long x 180.0 cfm per 10 feet of length = 4,320 cfm.

It should be noted here that for the purpose of computing total air quantity, the ducts should be considered to extend the full length of the storage. Actually the ducts should terminate about 4 feet from each end wall.

The inlet damper area should be based on an inlet velocity of 1,000 feet per minute. For the above-mentioned storage, the inlet damper

Table 1.--Chart for duct sizing in white potato storages when delivery ducts are spaced 8 feet on center

Length of ducts in feet	Number of ducts attached																																									
	1		2		3		4		5		6		7		8		9		10		11		12		13		14		15		16		17		18		19		20	
	Depth	Width	Depth	Width	Depth	Width	Depth	Width	Depth	Width	Depth	Width	Depth	Width	Depth	Width	Depth	Width	Depth	Width	Depth	Width	Depth	Width	Depth	Width	Depth	Width	Depth	Width	Depth	Width	Depth	Width	Depth	Width	Depth	Width	Depth	Width	Depth	Width
	In.	In.	In.	In.	In.	In.	In.	In.	In.	In.	In.	In.	In.	In.	In.	In.	In.	In.	In.	In.	In.	In.	In.	In.	In.	In.	In.	In.	In.	In.	In.	In.	In.	In.	In.	In.	In.	In.	In.	In.	In.	In.
100	26	20	36	24	48	24	64	24	75	24	84	24	97	24																												
90	24	20	33	24	43	24	57	24	70	24	80	24	88	24																												
80	22	20	38	20	40	24	52	24	62	24	75	24	80	24	88	24																										
70	20	20	33	20	43	20	46	24	55	24	65	24	75	24	80	24	88	24	97	24																						
60	18	20	29	20	40	20	42	24	49	24	57	24	65	24	75	24	80	24	88	24	92	24																				
50	16	20	26	20	35	20	36	24	42	24	48	24	55	24	62	24	70	24	75	24	80	24	88	24	92	24	97	24														
40	14	20	22	20	29	20	31	24	36	24	42	24	46	24	52	24	57	24	62	24	65	24	75	24	78	24	80	24	84	24	88	24	92	24								
30	12	20	18	20	24	20	29	20	34	20	34	24	37	24	42	24	48	24	49	24	52	24	57	24	60	24	65	24	70	24	75	24	78	24	80	24	84	24	88	24
20	10	20	14	20	18	20	22	20	22	24	24	24	27	24	31	24	34	24	36	24	38	24	42	24	44	24	46	24	48	24	52	24	55	24	57	24	60	24	62	24
10	8	20	10	20	12	20	14	20	16	20	18	20	20	20	22	20	24	20	26	20			29	20			33	20			38	20										

Note:
(1) The underlined figures are those used in the example problem.
(2) Dimensions shown on right of dark line should be avoided when sizing underfloor ducts. These dimensions apply to main ducts from overhead or outside ventilation equipment.

area should be: 4,320 cubic feet per minute ÷ 1,000 feet per minute = 4.3 square feet = 619 square inches. The exhaust damper area should at least equal the inlet damper area. The total damper area is: 619 x 2 = 1,238 square inches. A damper 35 by 35 inches would satisfy the requirements.

Fan: The fan and motor selected should be capable of supplying the needed quantity of air against 0.25 inch static pressure, water gage. The motor should be provided with thermal overload protection and all equipment and wiring should meet local and underwriters' code requirements.

SUGGESTIONS FOR MODIFYING EXISTING STORAGE HOUSES

Recommendations for modifying existing storages depend largely on the condition and design of each individual storage. The following are offered as suggestions rather than as recommendations, because of the variation in design of existing structures.

Suggestions Regarding General Structure

Unless the building has been specifically designed for bulk storage of potatoes and is known to be in sound condition, a competent engineer should investigate the building to determine whether it has sufficient structural strength. The structure must be sound and tight.

Insulation

Any aboveground structure to be used for storage should have an equivalent of at least 3 inches of mineral wood insulation in the walls and 4 inches in the ceiling. A suitable vapor barrier, as previously described, must exist or be applied on the interior side of the insulation. This vapor barrier must be protected from damage by potatoes or handling equipment.

Ventilation Duct and Floor

If the storage has an earth floor the most satisfactory method of modification is to follow the recommendations previously outlined for new storages. If the existing floor is of poured concrete or wood construction, and it is impractical to remove it, the following suggestions may be helpful:

1. Wood ducts may be built up above floor level to obtain proper ventilation of potatoes. These ducts, if properly designed, may in some instances prove practical for removing potatoes from storage with a duct unloader. To accommodate such an unloader, the ducts should afford a free opening of at least 12 inches above floor level. Such ducts could be made in sections for easy removal.

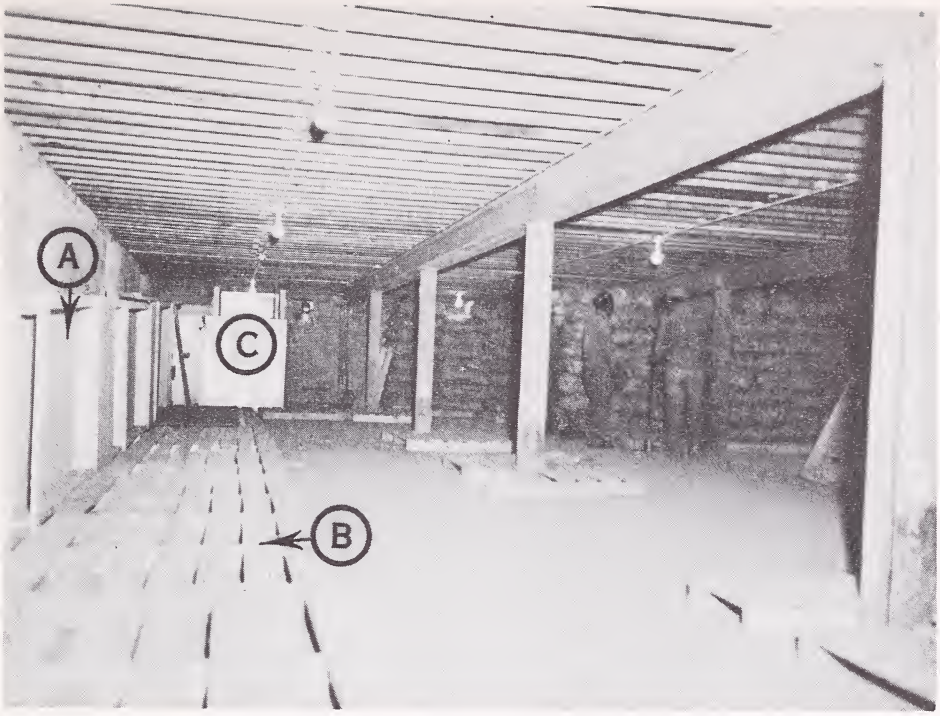

Figure 9.--Interior of remodeled potato storage where ventilating air is introduced under a false door. Note main air duct A, against wall at left of photo, false floor B, and fan and damper housing C at rear.

2. The entire floor area may be covered with pallets (fig. 9). This method should be very practical if bag storage is contemplated and an industrial fork-lift truck is available for handling. The use of palletized 1-ton boxes should also prove effective for bulk handling under similar conditions.

3. A slatted false floor may be used to cover the entire area for either bulk or bag handling. Such a method will introduce considerable difficulty in removing bulk potatoes from storage. If pallets or false floors are used, they take the place of delivery ducts. Where slatted floors or pallets are used it is generally most practical to introduce air under the slatted floor from a delivery duct running the length of one wall. (See fig. 9.) The false floor supports must then run at right angles to the duct to allow air flow under the false floor.

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